CLAIMS

1. A method of operating a node in an optical communications network including

a) receiving at the node an optical packet; and

b) generating from the said optical packet received at the said node a regenerated optical packet having a phase determined by a local clock source and independent of the phase of the said packet received at the node.

2. A method of operating an optical regenerator comprising:

a) receiving an optical packet at an input of the regenerator; and

b) generating from the said optical packet a regenerated optical packet having a phase determined by a local clock source and independent of the phase of the said packet received at the node.

3. A method according to claim 1 ~~or 2,~~ in which the step of generating a regenerated optical packet includes gating, using the received optical packet, an optical clock signal from the local clock source.

4. A method according to claim 3, including:

i)measuring the phase of the said optical packet;

ii) depending on the result of step (i), modifying the phase of the optical packet; and

iii) subsequently applying data signals from the optical packet as a control signal to gate means arranged to gate the said optical clock signal.

5. A method according to claim 4, in which in step (I) comprises measuring the phase difference between the incoming optical packet and the local clock source.

6. A method according to claim 4 ~~or 5,~~ in which the gate window is equal to the bit period.

7. A method according to claim 4 ~~any one of claims 4 to 6~~, in which the phase difference between the optical packet and the local optical clock is detected by means of a nonlinear interaction between the clock signal and the optical packet,

8. A method according to claim 7, in which the nonlinear interacton occurs in an optical fibre device.

9. A method according to claim 7, in which the nonlinear interaction occurs in a semiconductor device.

10. A method according to claim 9, in which the nonlinear interaction is a process of four-wave mixing.

11. A method according to claim 4 ~~any one of claims 4 to 10,~~ in which the phase of the optcial packet is modified by passing through a wavelength converter and a dispersive optical delay line.

12. A method according to claim 3, including:

passing the optical clock signal through each of a plurality of gate means;

applying data signals from the received optical packet as a control signal to each of the plurality of gate means with different delays of a fraction of a bit period relative to the optical clock signal input to the gate means; and

selecting the output of one of the plurality of gate means to provide the regenerated optical packet.

13. A method according to claim 12, in which the difference in delays is equal to T/k where T is the bit period and k is the number of optical gate means.

14. A method according to claim 12 ~~or 13,~~ in which the width W of the gate window is not less than T/k and not more than T, where T is the bit period and k is the number of optical gates.

15. A method according to claim 12 ~~any one of claims 12 to 14;~~ including making a measurement of a parameter of an optical signal output from the gate means, and selecting the output of one of the plurality of gates to provide the regenerated optical packet depending on the results of the said measurement.

16. A method according to claim 15, in which the said parameter is the energy of the optical signal.

17. A method according to claim 16, including comparing the energies of the signals from the plurality of gate means and making the said selection depending on the results of the said comparison.

18. A method according to claim 15, in which the said parameter is derived from the number of bit errors in the optical signal, and the signal with the lowest number of bit errors is selected to provide the regenerated optical packet.

19. A method according to ~~any one of the preceding claims~~ claim 1, including further processing the regenerated optical packet in optical processing means clocked by a signal from the local optical clock source.

20. A method of operating a communications network comprising a plurality nodes interconnected by an optical transmission medium, the method including:

transmitting an optical packet onto the network,

and at a network node, receiving the said packet and generating from the said packet a regenerated optical packet having a phase determined by a local optical clock source and independent of the phase of the said packet received at the network node.

21. A method according to claim 20, including receiving at the network node optical packets from a pluraltiy of different sources and having different respective phases.

22. A method according to claim 20 ~~or 21~~, further comprising outputting the regenerated optical packet onto the optical transmission medium.

23. A regenerator for optical packets including a local optical pulse generator comprising a free-running oscillator independent in frequency and phase from the packet source.

2~~4~~. A regenerator for optical packets comprising:

a) means for receiving an optical packet; and

b) means for generating from the said optical packet received at the said node a regenerated optical packet having a phase determined by a local clock source and independent of the phase of the said packet received at the node.

a 25. A regenerator according to claim 23 ~~or 24~~, including gate means controlled by a data signal from an optical packet and connected to a local optical clock source.

26. A regenerator according to claim 25, including

a plurality of gate means each arranged to receive a clock signal from a local optical source and a control signal from a packet received at the regenerator;

means for generating different delays of the control signals relative to the clock signals at different respective gate means;

means for selecting an output from one of the plurality of gate means.

27. A regenerator according to claim 26 including at least four gate means.

28. A regenerator according to claim 27, in which the ratio W/T of the gate window W to the bit period T lies substantially in the range 0.7 to 0.85.

a 29. A regenerator according to claim 14 ~~any one of claims 14 to 18~~, in which the local optical clock source is a mode-locked laser.

30. A regenerator according to claim 29, in which the mode-locked laser is passively mode-locked.

a 31. A node for connection in an optical communications network and including a regenerator according to claim 24 ~~any one of claims 24 to 30~~

a 32. A node for connection in an optical communications network and arranged to operate by a method according to claim 1 ~~any one of claims 1 to 22~~.

a 33. An optical communications network including a node according to claim 31 ~~or 32~~.

34. A regenerator according to claim 24 including means for measuring the phase of the optical packet, and means responsive to the said means for measuring for modifying the phase of a control signal applied to gate means, which gate means gate the optical clock signal thereby producing the regenerated optical packet.

35. A regenerator for optical packets according to claim 23, including an optical gate controlled by the data bits in the incoming packet, and the output of the local optical pulse generator is connected to the input of the said optical gate, and means to detect the phase difference between the incoming packet and the local optical pulse generator, and means to shift the phase of the control signal applied to the optical gate in correspondence with the said detected phase difference in such fashion as to obtain a correctly regenerated optical data packet at the output of the said optical gate.

36. A regenerator according to claim 34 ~~or 35~~, in which the gate window width is equal to the bit period.

37. A regenerator according to claim 34 ~~any one of claims 34 to 36,~~ in which the phase difference is detected by means of a nonlinear optical interaction between the local optical pulse generator and the incoming data packet.

38 A regenerator according to claim 37, in which the phase difference is detected by means of a nonlinear optical interaction between the local optical pulse generator and the incoming data packet and said nonlinear optical interaction occurs in a fibre device.

39 A regenerator according to claim 37, in which the phase difference is detected by means of a nonlinear optical interaction between the local optical pulse generator and the incoming data packet and said nonlinear optical interaction occurs in a semiconductor device.

40. A regenerator according to claim 39, in which the said nonlinear optical interaction is four wave mixing.

41. A regenerator according to ~~any one of claims 34 to 40,~~ claim 34 in which the means to shift the phase of the control signal includes an optical path having a variable delay.

42. A regenerator according to ~~any one of claims 34 to 40,~~ claim 34 in which the means to shift the phase of the control signal consists of a plurality of optical delay lines having different respective delays, and means for switching the control signal through a selected one of the plurality of optical delay lines.

43. A regenerator according to ~~any one of claims 34 to 40~~ claim 34, in which the means to shift the phase of the control signal consists of a wavelength convertor and a dispersive optical delay line.

44. A regenerator according to claim 43, which the said dispersive optical delay line consists of an optical fibre.

45. A regenerator according to claim 43, in which the said dispersive optical delay line consists of a fibre grating device.

46. A regenerator according to ~~any one of claims 34 to 45~~ claim 34 including a feed-forward open loop contol system in which the phase of the incoming packet is detected before passing through the phase shifter.

47. A regenerator according to ~~any one of claims 34 to 45~~ claim 34 including a feed-back closed loop control system in which the phase of the incoming packet is detected after passing through the phase shifter.

48. A regenerator according to claim 29, in which the mode-locked laser is a ring laser.

49. A node for an optical communications network including a regenerator according to ~~any one of claims 34 to 48.~~ claim 34

50. An optical communications network including a node according to claim 49.

51. An optical network in which bit-asynchronous regenerators are located at switching nodes.

52. An optical communications network according to claim 33, ~~or 50 or 51~~ in which the links between nodes carry packets in a bit-synchronous fashion.

53. A network according to claim 52, including bit-synchronous regenerators in links between nodes.

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54. A method according to to Claim 4 1 ~~any one of claims 4 to 10,~~ in which the phase of the optical packet is modified by passing the optical packet through an an optical path having a variable delay.

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55. A method according to to Claim 4 1 ~~any one of claims 4 to 10,~~ in which the phase of the optical packet is modified by passing the optical packet through a selected optical delay path.